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connected chain of conductors or neurons which transmits avalanche-like (*lawinenartig*) any single sense impressions on the periphery to an ever growing number of cells and fibres until it finally reaches the cortex. Thus in the fovea centralis retinae, in which the vision is clearest, one rod affected by light stimulus transmits the excitation to a bi-polar cell; this conducts it further to a ganglion cell beneath it (cell of the ganglion layer), the nerve process (*Fortsatz*) of which, branching out richly in the fore corpora quadrigemina, spreads the movement over a considerable number of cells, and finally the axis cylinders of these cell groups end in the occipital part of the cortex, where they come into contact by means of their branches (*Verzweigungen*), with the end brush-like formations of a large number of pyramidal cells. Thus the original peripheral unit of excitation has been able to impart its excitation to hundreds or perhaps thousands of nerve cells in the cortical centres of vision. (Spencer's analogy *re* mode of increased momentum of nerve movement—a row of bricks falling—might be suggestive here also.) So with the other senses.

The second part deals with *hypotheses concerning the histological mechanism of association of ideas, of sleep, and of the waking condition*. Duval's "*geniale*" histological hypothesis concerning the nature of sleep and rest, viz., the condition of *contact* between the nerve cells and their processes, is rejected. So also is Rabl-Rückhard's well-known hypothesis of the amoeba-like prolongations and retractions of the nerve fibres and end brushes in thought and sleep respectively. The chief causal mechanism in association, etc., Ramon y Cajal attributes to the neuroglia cells. Here we have the pseudopodian movements of contraction and relaxation. During their state of relaxation their pseudopodia extend and intervene between the cells and their protoplasmic processes and the nerve branches (*Verzweigungen*), in consequence of which the passage of the nerve currents is either completely stopped or considerably hindered. Thus we may gain an explanation of the nature of mental rest and of sleep, both natural and artificial (narcotics, hypnotism). The third part is on the *theory of attention*. One of the three kinds of neuroglia cells are the *perivascular* cells. These are found only in the neighborhood of the capillaries of the gray substance. Each capillary has inserted in it thousands of these neuroglia pseudopodia, which diverge in all directions. Upon contraction of these there follows a local enlargement of the vessels, and thereby greater physiological congestion. This congestion of the capillary vessels increases their size, filling out almost the whole of the surrounding lymph space. Hence the *monoideism* of attention. At the close of the article, which is full of suggestions and details, the author calls attention to the hypothetical nature of some of his conclusions.

ARTHUR ALLIN.

II. EXPERIMENTAL.

Die Aufmerksamkeit und die Function der Sinnesorgane. Von DR. W. HEINRICH. Erster Beitrag. Zeitschrift für Psychologie und Physiologie der Sinnesorgane, IX, Heft 5 u. 6.

The latter part of this article is experimental in nature. Helmholtz ("Physiol. Optik," 1867, S. 741) makes the assertion that attention is independent of the accommodation of the eye, basing his assertion upon the facts of indirect vision. While steadily fixating

an object centrally, the attention may be turned to an object on the side, with the result that while there is no change in the accommodation of the eye, there is in the attention, and in the objects perceived. So Helmholtz, and also Pilzecker in his train.

Heinrich points out that Helmholtz's statements are only the results of subjective perception; there is need of an objective investigation, as "self-analysis" may not reveal the state or change of the eye during the experiment. He therefore observes the pupils and lens with the help of an ophthalmometer. He determined carefully the size of the pupil (1) in central fixation, (2) in indirect vision, and (3) in reckoning. From the various tables it is evident that when the subject turns his attention to the object seen on the side, the pupil enlarges. For example, Table III gives the size of pupil centrally fixated at 3.0091 mm.; with object seen at angle of 50° as 4.9094 mm.; and at 70° as 3.9514 mm.; and during mathematical calculation at 6.0565 mm. The size of the pupil varies continually. If the attention be claimed by non-optical impressions, the pupil loses its condition of accommodation. Helmholtz is wrong therefore; the attention, at least in this case, is accompanied by the accommodation of the eye.

Dr. Haab (*Neurologisches Centralblatt*, 1886, 1 Mai, and in *Correspondenzblatt f. Schweizer Aerzte*, 1886, 15 März) reports a case of pupil-reflex not noticed by Heinrich. Again it is a case of indirect vision and attention; but here it is not an enlargement, but a contraction of the pupil! He regards it as probably of cortical origin and cites psychiatric cases to illustrate his argument. The discrepancy between the statements of Haab and Heinrich is probably due to the objects fixated (lamp, dark wall, etc.) and the respective positions occupied by the subjects examined. The different results, however, demand more experimentation. In either case, however, Helmholtz's view is amply refuted.

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Das Verhältniss von Accommodation und Konvergenz zur Tiefenlokalisation. Von Dr. FRANZ HILLEBRAND. *Zeitschrift für Psychologie*, VII, 1894, 97-151.

On the Relation of Accommodation and Convergence to Our Sense of Depth. By E. T. DIXON, *Mind*, N. S. IV, 1895, 195-212.

In the experimental study of the relation of accommodation to space perception, Hillebrand's sole predecessor is Wundt, who published on the subject more than thirty years ago. Wundt's general conclusion was that, all other means of perception being excluded, differences of distance could be perceived by differences in an "accommodation feeling;" Hillebrand's is that such a feeling does not exist. This conclusion rests on two series of experiments. In one a fixation line was moved slowly to or from the eye of the observer, and he was required to say whether it was approaching or receding; in the other, the observer's eye being accommodated for a fixation line at rest in the field, the line was suddenly removed and another at the same or a different distance substituted for it. For the detail of the apparatus and for the many necessary precautions to be observed, the original should be consulted. Suffice it to say here that with possibly one small exception to be noticed below, the conditions leave nothing to be desired. The first series of experiments showed an almost uniform inability on the part of the observers to judge—much less to "sense"—the direction in which the line was traveling. In the second series it